Aalto University
School of Science
and Technology

HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

HELSINKI
INSTITUTE FOR
INFORMATION
TECHNOLOGY

Floating Content: Infrastructure-less Information Sharing in Urban Environments

Jussi Kangasharju, Jörg Ott, Ossi Karkulahti
Esa Hyytiä, Jorma Virtamo, Pasi Lassila
Tobias Vaegs

Infrastructure-less Content Sharing…

- Ad-hoc local social network-style information sharing: Digital graffiti w/o servers and infrastructure

- Leaves notes, comments, stories, etc. in places

- Define reach (area of interest) and lifetime

- Leverage delay-tolerant ad-hoc communication between mobile devices for information replication & acquisition

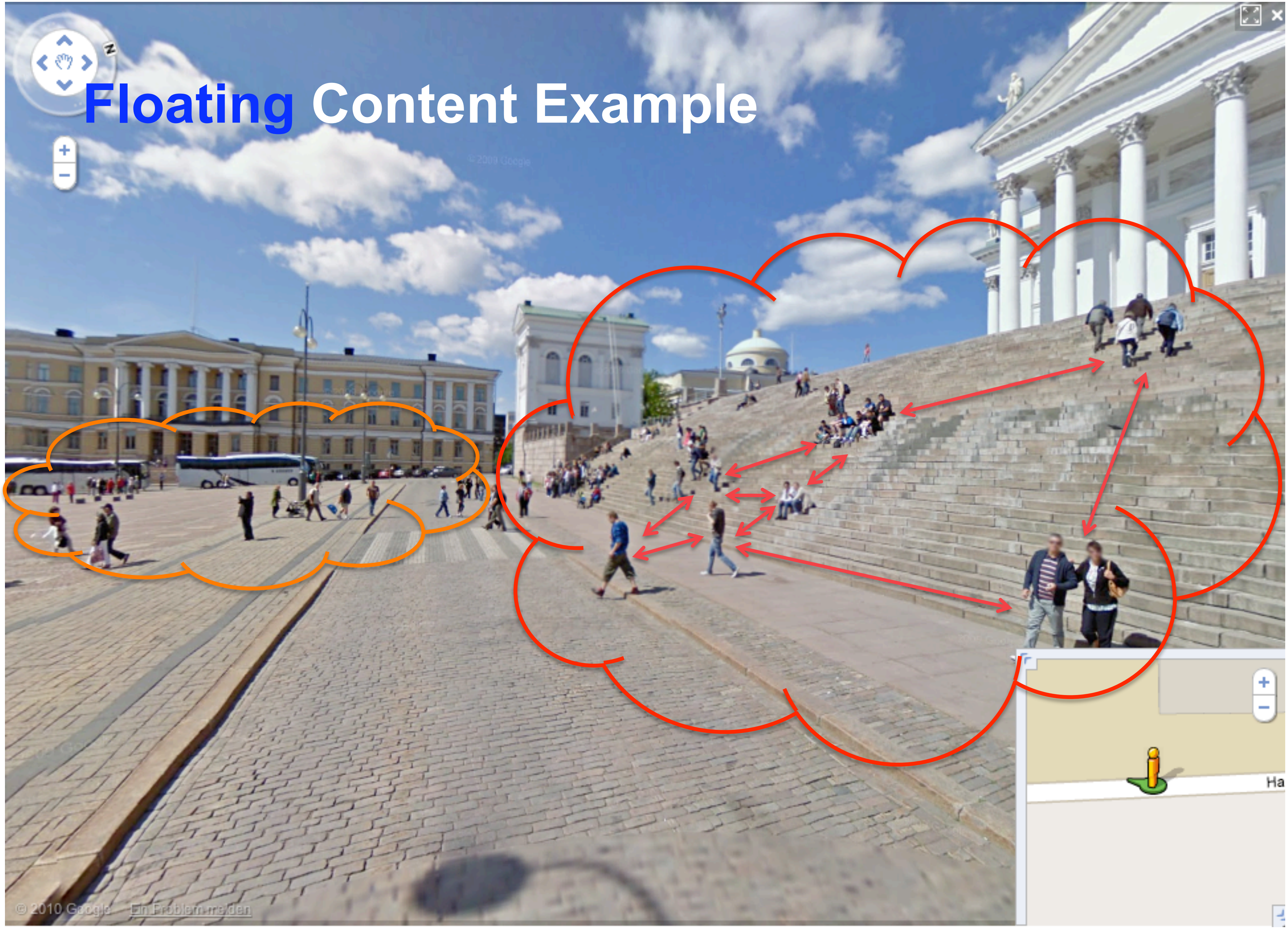
…in Urban Environments?!

- Location privacy
- Content “privacy”
- Connectivity (to infrastructure)
- Geographic validity
- Temporal validity
- User identification

Novelty?

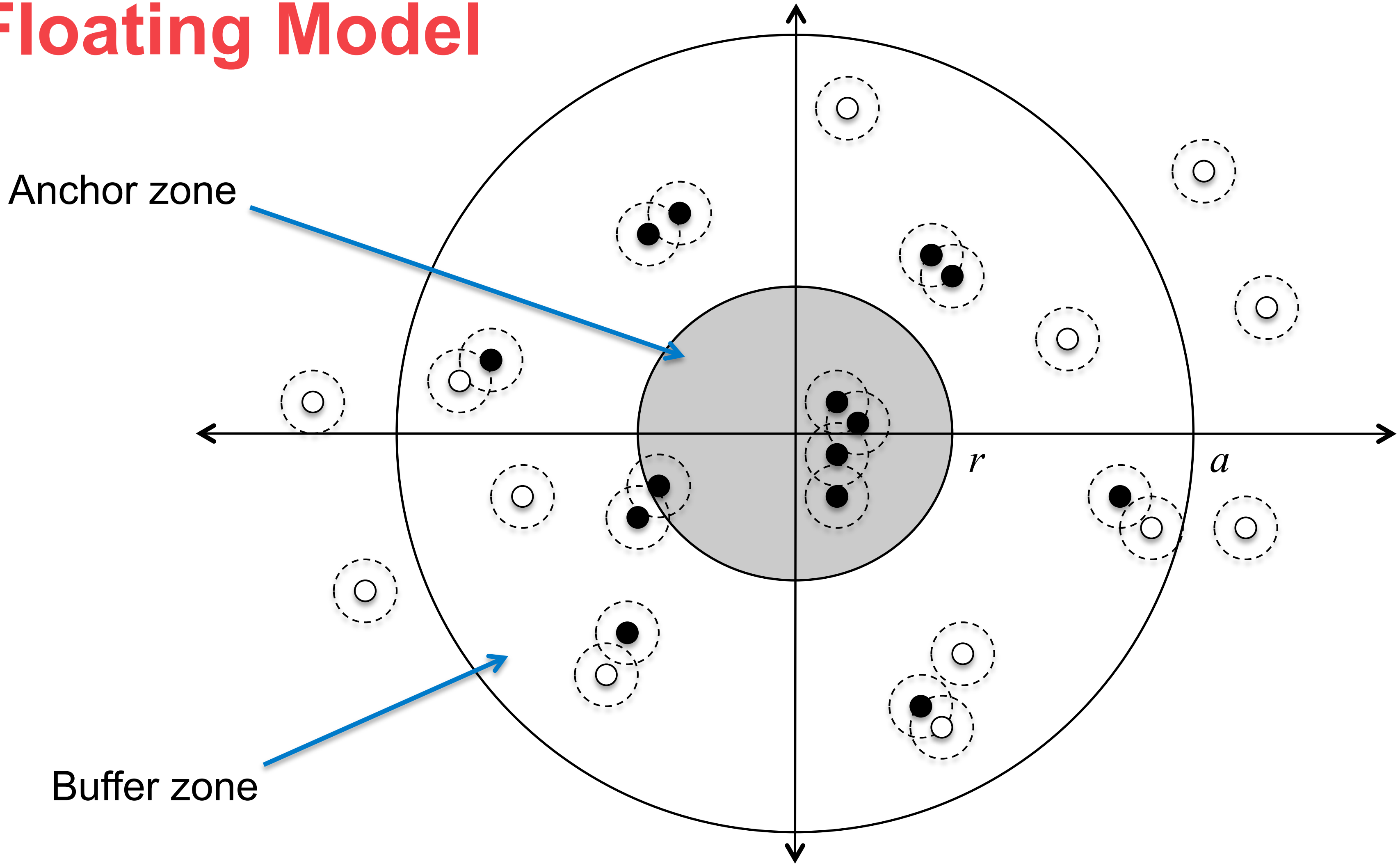
- Similar concepts have been “floating” around
  - At least as early as 2005 on floating
  - Geocasting and other approaches in late 90’s
- Related work often limited in scope
- Our contribution:
  - Thorough evaluation on feasibility
  - Figure out how to make this work in practice

Floating Content Example




Kirkkokatu
Helsingin yliopiston kirjasto
Universitetsgatan
Hallituskatu
Helsingin tuomiokirkko
Snellmaninkatu
Ravintola Oluttkellari Helsinki
Hallituskatu
Studium Catholicum
Unioninkatu
Ritarihuone-Riddarhuset
Senaatintori
Kraft/ Kiseleffin talo
Aleksanterinkatu
Musiikki Hellas
Alexandersgatan
Capital Crew Helsinki Oy/ Valkoinen Sali
Työ- ja elinkeinoministeriö
Aleksanterinkatu
20
Balderin Sali
Ristorante Siciliano
Levytukku Oy
Café Engel
seimi shop
Ritarihuone
Sederholmin talo Helsingin kaupunginmuseo
Unioninkatu
Sofiankatu
Katariinankatu
Helenankatu

Floating Model



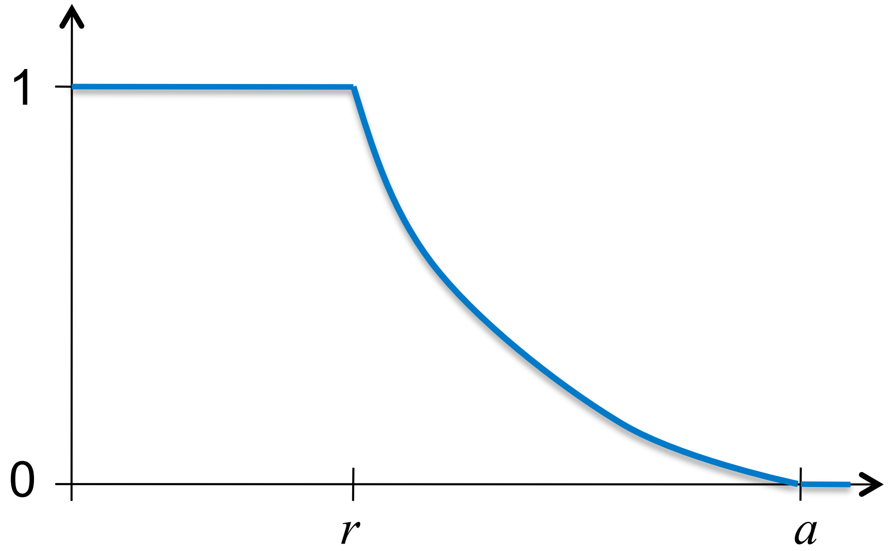
Replication & Deletion

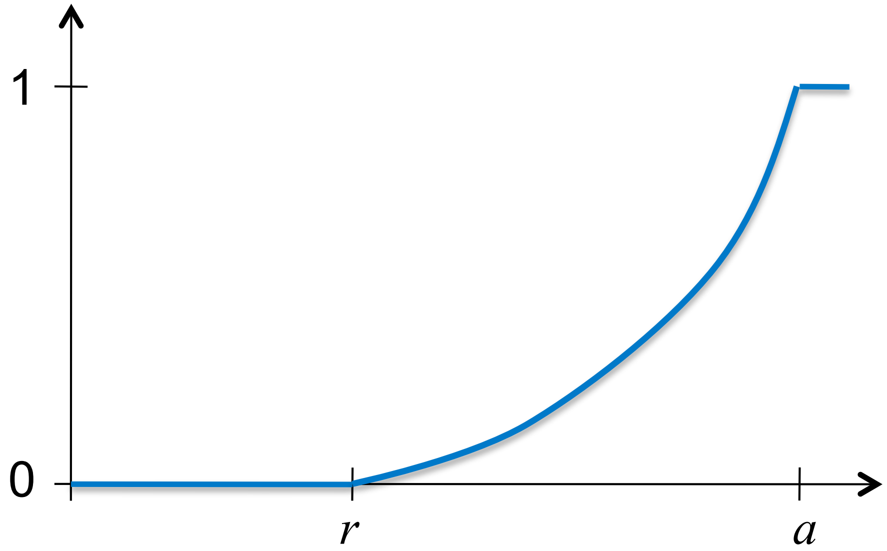
Replication

- f(d) from anchor point
- r, a for priority scheduling
- 1 within anchor zone

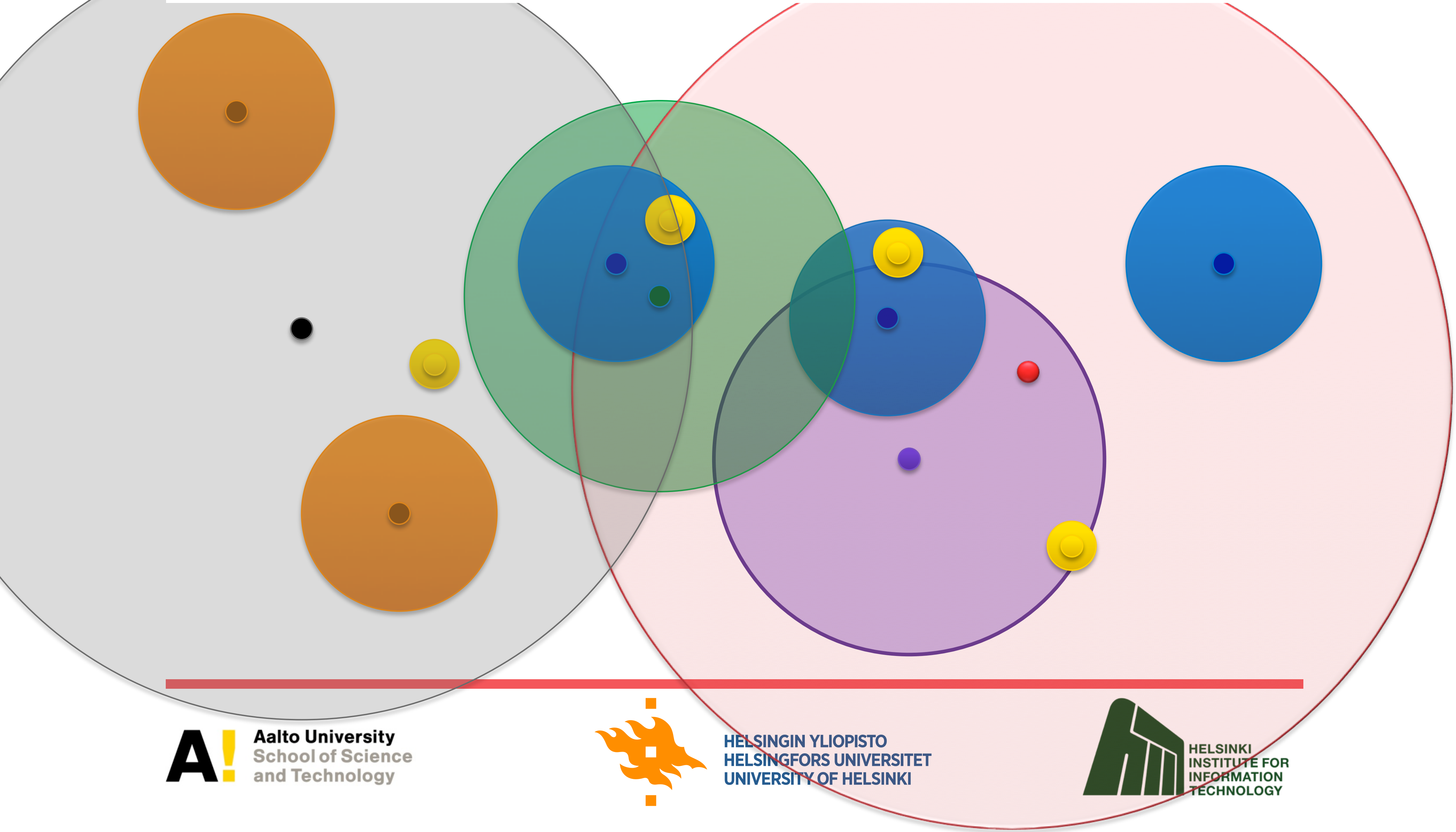
Deletion

- Only if buffer space needed
- f(d) from anchor point
- r, a as tie breakers
- TTL-based deletion





Content spread and prioritization



Aalto University
School of Science
and Technology

HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

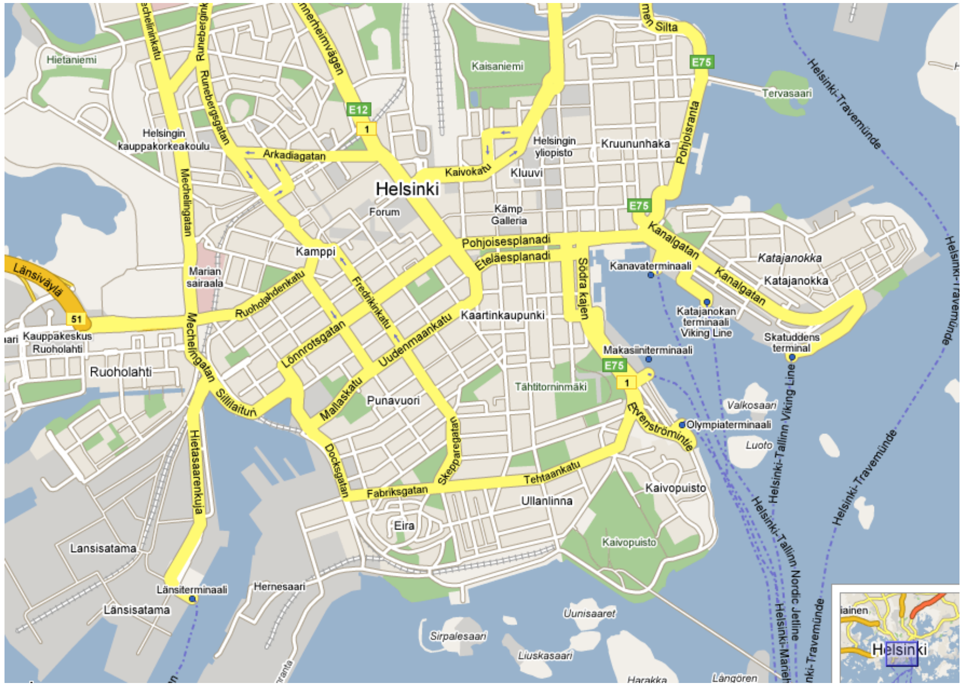
HELSINKI
INSTITUTE FOR
INFORMATION
TECHNOLOGY

Two-Pronged Approach to Evaluation

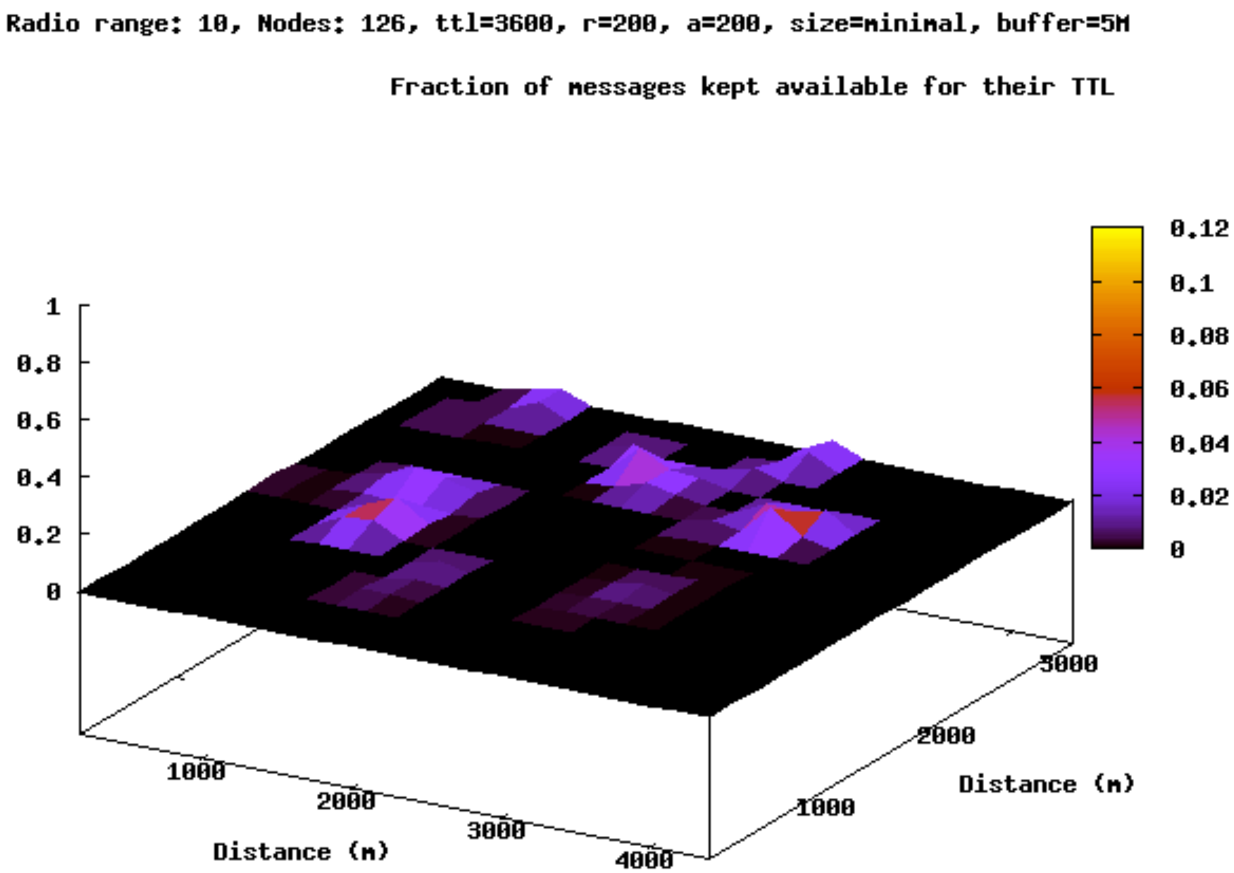
- Analytical modeling
  - Not covered in this talk
  - Different scenarios, different mobility models
  - Main result: Criticality condition
- Simulations
  - Initially simple simulations to test feasibility
  - First result: Need 1 person per 50m^2 on average
  - This agrees with analytical criticality condition
  - In this talk: More detailed simulations

Some Simulation Findings

- ONE Simulator: 4500 x 3400m simulation area
  - Helsinki City Scenario
  - Restless nodes (tourists)
    - Moving around along shortest paths between points of interest
    - On foot, by car
    - Some trams following regular routes
  - 126, 252, 504 nodes
  - 10m, 50m radio range
  - r = a = 200m, 500m



Unsuitably low density

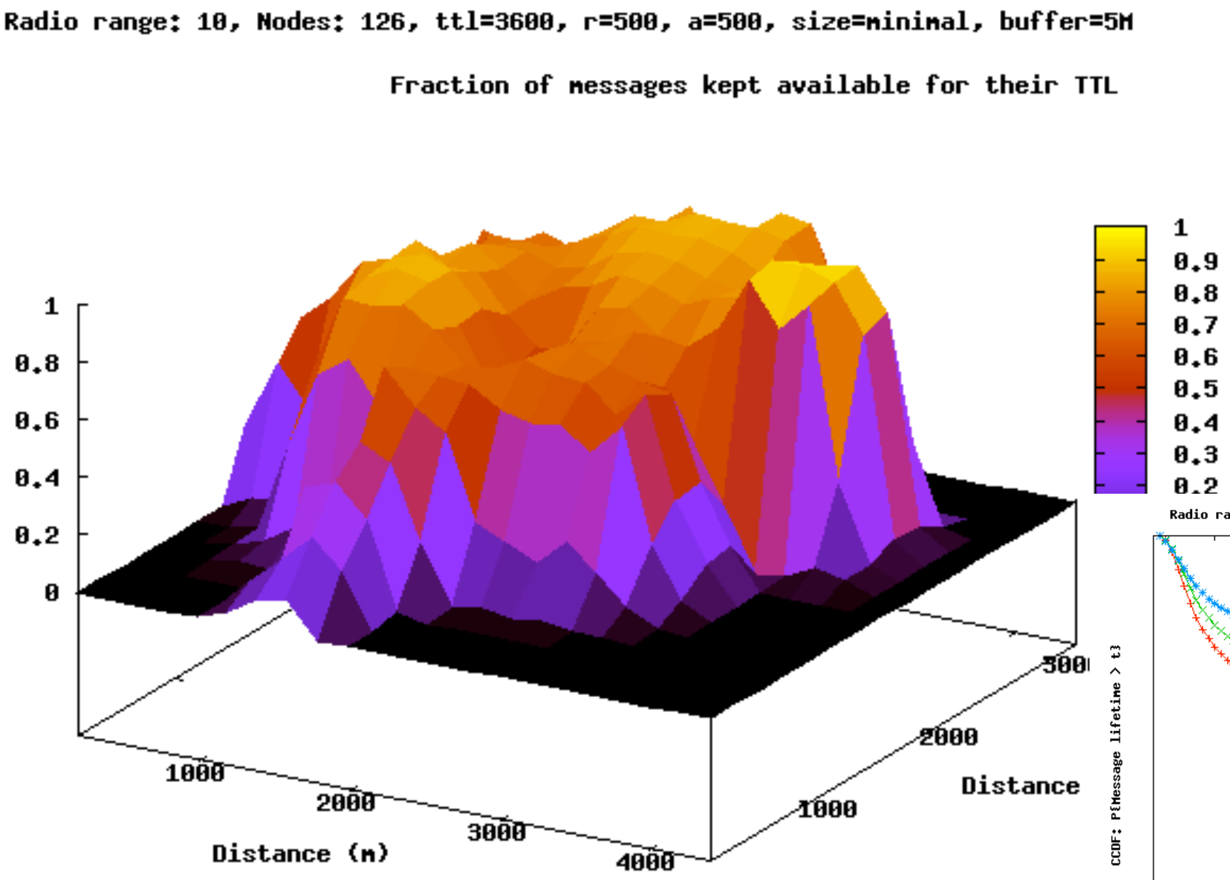


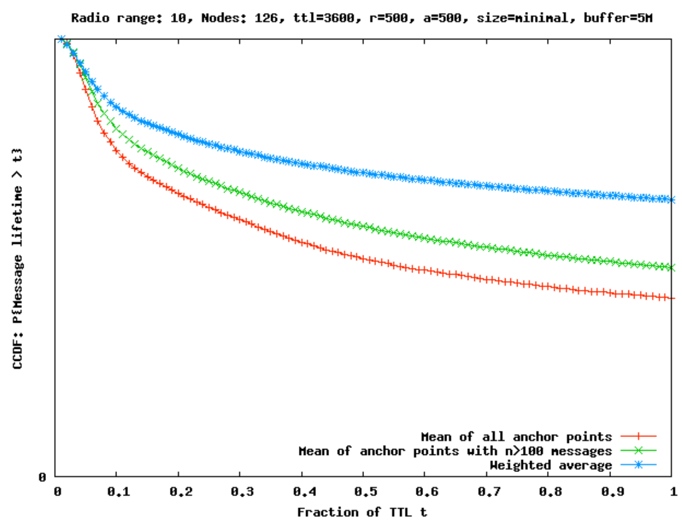
Aalto University
School of Science
and Technology

HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

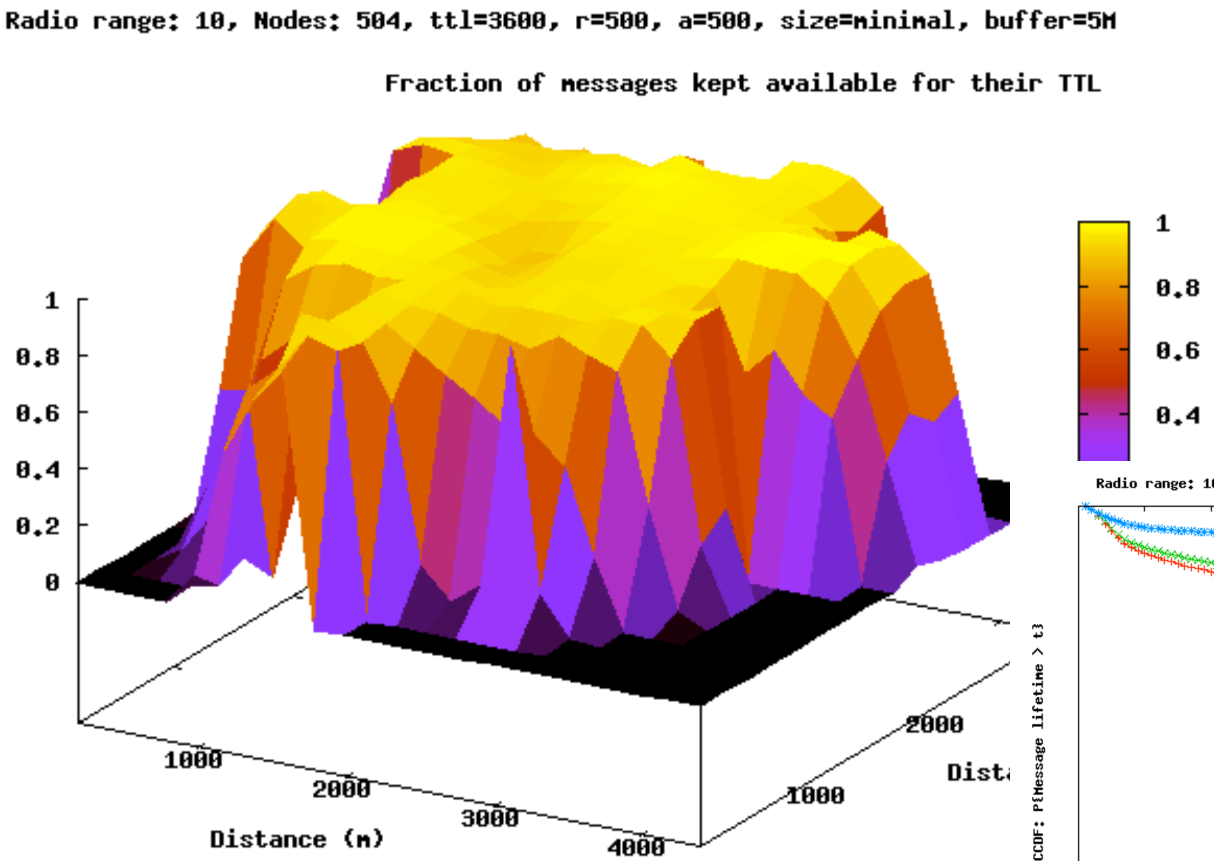
HELSINKI
INSTITUTE FOR
INFORMATION
TECHNOLOGY

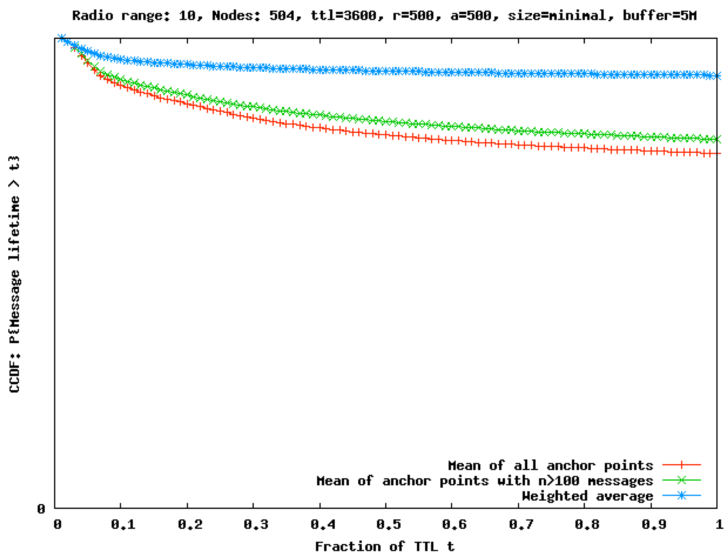
Larger anchors





Closer to a "reliable" environment





Aalto University
School of Science
and Technology

HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

HELSINKI
INSTITUTE FOR
INFORMATION
TECHNOLOGY

Some Conclusions

- Simple, yet appealing geo cooperation model
- Workable already for modestly dense scenarios
  - Simulations agree well with theoretical modeling
- Some built-in DoS protection and garbage collection
- API and content sharing applications to come
- Best effort model: user acceptance?

Present & Future Work

- Theoretical foundations about criticality criteria
  - Paper under submission
- More extensive simulation studies
  - Impact of location fuzziness
  - More diverse mobility models
  - Varied offered loads, resource sharing
  - Paper under submission
- Implementation for Android in progress
  - Uses RFC 5050 message format as a basis
    - Plus TCP CL and node discovery drafts